the use of small samples for research (see Chapter 4 and p. 228) and probably stands out because of the recent media attention to Paleoindians. The chapters on demography are focused more on classic research in paleodemography and population history than on more recent work, and there is no discussion of mtDNA mismatch and intermatch distributions, which could provide evidence to support the notion of a demic expansion of early populations in the Americas.

Overall, *The Origins of Native Americans: Evidence from Anthropological Genetics* provides an extremely useful and insightful examination of Native American biology. The volume will certainly be of interest to those outside the field of anthropological genetics and should serve as a reference work for those in the field. The breadth of this work and Crawford's ability to use Native American biology to illustrate important evolutionary concepts make this an excellent addition to the bookshelves of those working with past or present populations of the Americas.

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PHENOTYPIC EVOLUTION: A REACTION NORM PERSPECTIVE. By Carl D. Schlichting and Massimo Pigliucci. Sunderland, MA: Sinauer. 1998. 387 pp. ISBN 0-87893-799-4. $38.95 (paper).

This is a very good book on a timely topic. Biological anthropologists wanting a modern understanding of the role of genes in phenotypic variation and evolution would benefit from reading it. This is especially important because in human genetics we are in an age of strong expectations of simple determinative relationships between genotypes and phenotypes. These are driven by various motives, of glory and of gain, as powerful new methods raise hopes for both. Excess genetic determinism has the potential academic consequence of the acceptance of oversimplified if not highly unrealistic theories and assertions about complex traits (like behavior traits). There are also practical consequences, in the form of the funding devoted to biomedical genetics that inevitably drains funds from other avenues of research.

The evolutionary or modern synthesis was a proclamation of the middle of this century that defined biology as essentially a matter of genetic information, evolution as change in allele frequencies, and population genetics as the formal theoretical support for biology. In subsequent decades this was extended to a further genetic determinism by the dogma that the genome is the code book for life and that the flow of biological information is from genotype to phenotype via the one-gene one-one protein model. Virtually all biological anthropologists who were seriously trained in evolutionary principles beyond the hand-waving level were indoctrinated by the modern synthesis (and the problem could even be worse among hand-wavers). Indeed, until recently it was difficult to find texts or even much mainline material that was not based on this tacit formalization of biology.

However, the world does not have to follow theories proclaimed in an at least partly political coup d'etat. A proper understanding of biology requires an accurate understanding of the genetic basis of interesting phenotypes. Thanks to advances in genetic technology, several areas of biology are making a comeback after having been banished by the modern synthesis as unimportant, unscientific, or irrelevant. This book presents a more modern view than we can usually find in the journals or most textbooks. Anthropologists whose major interest is in complex traits, such as the skeleton, behavior, or growth patterns, will find in this book much of value. Genes are placed in context as but one of the factors, acting in many ways, by

which phenotypic variation in the biosphere arises.

The authors first review the history of ideas about complex traits. They note the complex pathways between genotype and phenotype and stress the modern research that reveals complexities of interaction among genes and between genes and environment. Aspects of evolution that are not purely gradualistic and in which complex adaptations can arise rapidly are discussed. Improved understanding has come as the result of a genetic renaissance in developmental biology and in the use of newly available genetic sequence data in comparative phylogenetic studies.

The authors present a theoretical basis for a norm-of-reaction, phenotypic plasticity view of biological phenotypes. A norm-of-reaction perspective considers the variation in a trait that can arise in genetically identical individuals developing or living in different environments. The authors provide evidence to argue that the developmental norm of reaction is itself an object of selection, that there are flexible mechanisms at many stages for regulatory reactions to varied conditions, and that the complexity of the interacting factors leads to the emergent property that is the phenotype.

The authors review basic theoretical perspectives on the evolution of complex traits, from experimental biology as well as quantitative genetics, and then outline theoretical ways to express ideas about reaction norms and phenotypic plasticity. A series of chapters deals in turn with various aspects of phenotypic variation. These include a treatment of allometry (essentially correlated variation among traits) and variation occurring during ontogeny (development), including concepts such as heterochrony, by which even small variation in the timing of events can yield substantial phenotypic variation.

Nonetheless, the amount of variation within and even between species is effectively constrained, and this requires explanation. For example, a trait, like the shape and size of an egg, can be described mathematically in terms of a few parameters. That formalism describes a large, multidimensional morphological space; however, we find that only a fraction of that space is or has ever been occupied by real creatures. The authors identify a number of constraining factors and processes and consider their relative importance. These include the inheritance of a genetic patrimony that cannot be flexed beyond some limits without untoward pleiotropic effects, the legacy of millions of years of prior evolution.

One problem in the evolution of complex, especially quantitative traits that are produced by the effects and interactions of many different genes and other processes is to understand how the components and their interactions can evolve. The authors analyze this problem with a device that appears in several places in the book, a diagram of correlations of varying strength among the components that contribute to a trait or organism. Such a visual device schematizes the limitations placed on any one of the components. Strong empirical correlations reflect constrained variation between two components, whereas weaker ones allow more variation (whatever the causes of the correlations). This is but one of many heuristic, schematic, or otherwise clever graphic devices used by the authors to give a clear picture of complex issues.

The authors consider norm-of-reaction effects that are due not to primary DNA sequence directly but to the way the genome is packaged, processed, and modified at different life stages. Some common developmental model systems are discussed in this light. Multiple ways of embryological development, the specification of cell fate in early development, and other topics are included. The role of gene expression switching by transcription factors like members of the homeobox gene family is considered along with other epigenetic factors in variation. *Epigenesis* is a general term referring to those things that are not due to the primary coding sequences of genes themselves. As such, epigenesis is widespread, perhaps ubiquitous, and we are probably just beginning to get an inkling of the diversity of its actions and effects.

The final substantive chapter in this book considers the evolution of reaction norms during development, putting many of the

concepts previously considered into a unified context. The book ends with a typical summing-up chapter.

It is difficult to provide a good sense of this book in a short review. The authors write well on timely subjects, control a broad wealth of knowledge, and raise examples ranging from the molecular to the morphological, animal to plant. The introduction alone will put many things in modern biology into clearer perspective, while the detailed middle chapters provide specific examples and some technical details. This is an advocacy book and in a sense too specialized for a standard course, but it would be an excellent choice for a graduate or upper level undergraduate seminar. Examples, illustrations, graphs, figures, and text explanations are compelling and keep the reader's interest. Examples range from natural to theoretical, experimental, and simulated. The technical detail is kept to a manageable level, but the intellectual level is not compromised. The authors are persuasive proponents of their viewpoint, which, while not novel to them, is very well articulated and to which, as contributors to the area themselves, they bring a fresh, modern, knowledgeable force.

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## BOOK RECEIVED

Lynnerup N (1998) *The Greenland Norse: A Biological-Anthropological Study.* Copenhagen, Denmark: Danish Polar Center. 149 pp. 225.00 DDK (paper).